Spinning Performance and Yarn Quality as Affected by Lint Color and Trash in Field-Exposed Cotton—1966-67 Crop Year

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Spinning Performance and Yarn Quality as Affected by Lint Color and Trash in Field-Exposed Cotton—1966-67 Crop Year

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Agricultural Research Service

Summary and Conclusions

This study was designed to evaluate the relationships of lint color resulting from field exposure to other fiber properties, manufacturing performance, and yarn properties. Twenty-seven bales of control cotton and 27 bales of commercial cotton from each of three areas were spun into 40's yarn, using standard manufacturing organizations. In a fourth area only 18 bales of cotton were obtained.

The control cotton was a commercially grown variety in each area of growth. It was mechanically harvested on three different dates and ginned by three different methods. At each harvest date, 9 bales of commercial cotton were purchased at each of three different grades—to determine whether lint color varied with purchase dates or with grades in the commercial market.

Among control cottons, 6 to 8 weeks' exposure in the field changed the average background color from Middling to Strict Low Middling, based on colorimeter measurements on clean lint. However, the classer was unable to detect this difference in ginned lint samples, and the colorimeter detected only a part of the difference in these samples. Although the differences in background color were related to other fiber data, color usually ranked lowest or next to lowest among fiber properties in correlation with processing performance and yarn qualities other than color of yarns.

Purchase dates of the commercial cottons made no significant difference in any of the color determinations or in foreign matter content.

Foreign matter, in both control and commercial cottons, significantly affected lint color determinations by both classer and colorimeter. In the control cotton, an increase in Shirley Analyzer [2] nonlint content from 3.2 to 9 caused an apparent one-grade reduction in lint color—the same as the real reduction caused by 6 to 8 weeks' exposure. However, after trash was removed from this ginned lint, there was no difference in color between the samples. The same was true in three grades of commercial cotton, although the smaller range of foreign matter (2.9 to 4.3 nonlint content) caused less than a full grade reduction in color readings of the ginned lint samples. Thus, in these cottons, prices of the cottons with the most trash would have been discounted twice—once for trash content and once for the apparent color reduction due to the same trash content.

Based on the findings of this study, it may be concluded that:

1. Any true difference in background color can be masked by variations in foreign matter, or artificial differences in color readings can result solely from variation in foreign matter.

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[2] Trade names are used in this publication solely for the purpose of providing specific information. Mention of a trade name does not constitute a guarantee or warranty of the product by the U.S. Department of Agriculture or an endorsement by the Department over other products not mentioned.

2. Background color usually is not highly correlated with processing performance or with yarn properties other than yarn color. Although a reduction in true lint color may indicate lower quality within a variety, a more accurate indication of final lint quality can be found in measurements of other fiber properties.

3. Present methods of grading and pricing cotton should be changed to separate trash estimates and color readings.

4. The present emphasis on lint color as a pricing factor should be reduced.

Introduction

Until recently, the color factor in grade of cotton varied widely throughout the harvesting season. However, with a more rapid harvesting of the crop through mechanization, the range in color grade, particularly as it may be associated with volume, has decreased considerably. Also, color and leaf are now considered to be the two principal elements of grade, and the interrelationship between the two may have changed as harvesting and ginning practices changed. In view of the switch to mechanical harvesting, the increased cleaning during the ginning process, and the reduced length of harvesting season, the traditional heavy emphasis on color and foreign matter in grading cotton probably needs to be reexamined.

Past study of cotton lint color and its relationship to the use value of cotton has been limited. In 1951 Nickerson [3] investigated the effects of field exposure on color and other fiber properties. In 1965 the U.S. Department of Agriculture's Pilot Spinning Plant, located at Clemson, S.C.[4] conducted a similar investigation based on 27 lots. They included spinning performance as a part of the study. Although their study was based on few observations, it indicated that the range of color due to exposure was very narrow. It brought out some relationship between color and other fiber properties as shown in the earlier study, but color was not significantly related to most processing variables. It also showed a strong dependence of color grade on the amount of foreign matter in the sample. The agreement of the 1965 and present studies strongly implies that, since 1951, the relationship of color and foreign matter to the use value of cotton may have changed.

Based largely on implications of the 1965 study, this larger study was designed to evaluate the effects of lint color on other fiber properties, manufacturing performance, and yarn properties when color differences were generated by field exposure in cottons of widely different levels of foreign matter. Specific objectives of the test were: (1) to determine the relationship of color to other fiber properties, to spinning performance, and to yarn quality; (2) to determine the extent to which foreign matter content affects color determinations; and (3) to recommend specific ways in which present methods of using color and foreign matter to establish relative use values could be improved, if a need for improvement were implied.

Since the 1965 study indicated that relationships of color to other fiber properties existed because of the controlled conditions in the test, a commercial phase of the present study was planned for comparison. The commercial phase was designed to approximate more closely actual conditions under which cotton is normally marketed than could be done in the controlled test.

Procedure

The cotton used in this study came from South Carolina, Mississippi, Texas High Plains, and Arizona. This study was divided into two parts, namely cotton from controlled experiments and cotton from commercial sources.

The 27 bales of control cotton from each area of growth were obtained from a preselected field, so that the defoliation, harvesting, and ginning could be carefully controlled. Cotton was machine stripped in the Texas High Plains area and machine picked in the other three areas.

[3] NICKERSON, DOROTHY. EFFECTS OF EXPOSURE AND STORAGE ON COLOR AND OTHER FACTORS OF QUALITY IN RAW COTTON. U.S. Dept. Agr. Prod. and Market. Admin., Cotton Div., Jan. 1951.

[4] SHANKLIN, EDWARD H., LAFERNEY, PRESTON E., and GARNER, WARREN E. COTTON COLOR AS RELATED TO OTHER QUALITY FACTORS, 1965-66 CROP YEAR. Presented at Annual Cotton Research Clinic and Marketing Conference, Pine Mountain, Ga., February 1967.

For three of the areas, the fields of cotton were defoliated only once after about three-fourths of the cotton had opened. For the Arizona area, the defoliation was performed after the first picking.

The fields were divided into strips of six rows each. Two rows of each strip were picked on the early, midseason, and late harvest dates.

The early harvest was performed as soon after defoliation as possible, with the midseason and late harvests following at 3 to 4 weeks' intervals.

Pink bollworm infestation prevented a late harvest in Arizona. All cotton remaining in the field after the first harvest was picked at the midseason.

For the South Carolina and Mississippi areas, in addition to the regular harvest, a top crop was harvested. The cotton came from the top of the stalk that had not opened at the time of the early harvest. The top crop opened between the early and midseason harvests and was picked from the same rows as was the early harvest.

The top crop harvested at midseason represented cotton that had been exposed to weather for about 1 to 4 weeks, while the top crop harvested during the late season represented cotton that had been exposed for about 4 to 7 weeks.

At the gin, the seed cotton from each harvest was divided into three lots of equal amounts. Each lot was then subdivided into three equal parts to be ginned as replications. Each lot was ginned using various procedures to give three levels of trash (referred to in this report as low, medium, and high). The gin's drying equipment was set to produce about 6 percent lint moisture for all gin-cleaning conditions.

The 27 bales of commercial cotton from each area used in this study were purchased from a gin that was in the general area from which the control cotton came. At the time that the control cotton was harvested, nine bales of commercial cotton were purchased from the selected gin.

By examining gin records, it was determined which bales had been ginned at about the same time as the control cotton. The modal grade for this cotton was established, and three bales of this were purchased, as well as three bales grading higher and three bales lower than the modal. This same procedure was followed at the midseason and late harvests.

For this report, the three grade levels are referred to as grades 1, 2, and 3. Grade 3 is the lowest and contains the largest amount of waste, while grades 2 and 1 have progressively less waste.

All cotton used in this investigation was shipped to the Pilot Spinning Plant, Clemson, S.C., for processing and testing.

Each bale was processed into yarn using a standard manufacturing procedure. Table 1 shows the yarn number, twist multiplier, and spindle speed used for cotton from each area of growth.

Samples for fiber testing were taken from each bale at the time of opening. All testing and processing were performed under standard atmospheric conditions.

Statistical analyses used in this study were of two general forms. Analysis of variance, in conjunction with Duncan's Multiple Range test, was used to determine the statistical significance of differences between treatment levels of fiber, processing, and yarn properties. The design was split-plot in randomized complete blocks, with exposure as the main-plot factor and ginning as the sub-plot factor. Multiple regression analysis was used to estimate functional relationships between color and foreign matter and the processing and yarn properties.

All analyses were computed separately for the commercial and control phases and for each area

TABLE 1.—*Yarn number, twist multiplier, and spindle speed used for control and commercial cottons*

Area of growth	Control cotton			Commercial cotton		
	Yarn	Twist multiplier	Spindle speed	Yarn	Twist multiplier	Spindle speed
South Carolina	40s	3. 54	12, 000	40s	3. 54	11, 500
Mississippi	40s	3. 54	12, 000	40s	3. 71	11, 500
Texas High Plains	36s	3. 80	13, 000	36s	3. 80	13, 000
Arizona	40s	3. 71	12, 000	40s	3. 71	12, 000

within a phase. As a basis for discussion in the text, beltwide averages of most properties are cited. Instances in which cotton properties in one or more areas departed substantially from the beltwide trend were few, and a consideration of them did not change the conclusions of this study. Yarn color indexes are not given for Texas and Arizona control cotton.

Appendix tables 9, 10, 11, and 12 show the effects of high, medium, and low trash levels on control cotton within each harvest period for each area of growth.

Results

Effect of Exposure— Control Cotton

Based on colorimeter measurements of cleaned-lint samples, background color decreased from Middling to Strict Low Middling due to exposure (table 2). However, the indicated drop in color was only about one-half grade when ginned-lint samples were measured by colorimeter. The classer found no difference. These results indicate the need for some kind of change in the present commercial use of color determinations. If color, over this narrow range, is a significant quality factor, then improved methods of detecting color differences must be developed. If color is no longer a major quality factor, the present emphasis on color in the marketing systems should be reduced.

Was color related to other measurements of fiber quality or to processing results? Table 2 indicates a tendency for fiber length and length uniformity, fiber strength, and micronaire to be reduced as the season progressed. These changes in fiber properties were also reflected in processing results. Ends down doubled from early to late seasons, and break factor was reduced by about 100 units. Yarn evenness was also decreased. Thus, in the controlled test, both fiber quality and processing results changed significantly over the same period in which lint color dropped by one full grade. Simple correlation coefficients, shown in table 3, reflect these relationships.

Lint color, under the carefully controlled test conditions, was quite highly correlated with measurements of processing performance and yarn

TABLE 2.—*Average properties of control cotton at three harvest periods, 1966 color and trash level study*

Property	Unit	Harvest [1]		
		Early, 36 lots	Mid-season, 36 lots	Late, 27 lots
Shirley Analyzer	Percent	5. 7	5. 6	5. 7
Classer's leaf grade	Index	92. 5	93. 9	93
Classer's color grade	do	92. 1	92. 8	91. 5
Colorimeter:				
Ginned lint	do	93	92	90
Cleaned lint	do	100	98	94
Classer's staple	1/32 inch	34. 2	33. 9	33. 6
2.5% span length	Inch	1. 09	1. 08	1. 07
50/2.5 uniformity ratio	Percent	45. 1	44. 5	44
Pressley strength	1,000 p.s.i.[2]	81	80	77
Micronaire	Reading	4. 5	4. 3	4. 1
EDMSH [3]	Number	46	83	101
Break factor	Unit	1, 884	1, 815	1, 778
Yarn irregularity	Percent	21. 8	22. 4	23
Yarn color:				
Gray	Index	98	97	92
Bleached	do	105	102	98
Bleached and dyed	do	104	99	95

[1] All results based on beltwide averages, except yarn color index, which is based on results from South Carolina and Mississippi only.
[2] Pounds per square inch.
[3] Ends down per 1,000 spindle hours.

TABLE 3.—*Simple correlation coefficients for selected dependent and independent variables,*[1] *control and commercial cottons*

Area of growth	Dependent variable	Independent variable					
		Control cotton			Commercial cotton		
		Classer's grade index	Colorimeter grade index		Classer's grade index	Colorimeter grade index	
			Ginned lint	Cleaned lint		Ginned lint	Cleaned lint
South Carolina	Yarn C.V.[2]	0. 20	0. 07	−0. 57	0. 74	−0. 62	−0. 56
	Yarn appearance	−. 25	−. 17	. 34	. 43	. 47	. 28
	Break factor	. 07	. 17	. 67	. 44	. 52	−. 28
	EDMSH[3]	−. 16	−. 19	−. 67	−. 13	−. 18	−. 61
Mississippi	Yarn C.V	. 52	. 57	−. 13	−. 15	−. 26	−. 11
	Yarn appearance	−. 39	−. 20	. 35	. 62	. 19	. 10
	Break factor	−. 55	−. 13	. 51	−. 05	. 27	. 33
	EDMSH	. 47	. 24	−. 19	−. 06	−. 30	−. 26
Texas	Yarn C.V	. 30	. 29	−. 24	. 13	−. 39	−. 20
	Yarn appearance	−. 23	−. 19	. 06	. 15	−. 30	. 12
	Break factor	−. 10	−. 06	. 26	−. 07	. 37	. 11
	EDMSH	−. 07	−. 05	−. 36	−. 04	−. 73	−. 04
Arizona	Yarn C.V	. 62	. 21	. 07	. 30	. 57	. 26
	Yarn appearance	−. 31	−. 26	. 03	−. 22	−. 49	−. 30
	Break factor	−. 56	−. 41	−. 24	−. 33	−. 32	. 11
	EDMSH	. 68	. 28	. 10	. 50	. 53	. 17

[1] Coefficients larger than 0.36 are significant at the 95% level. Coefficients larger than 0.47 are significant at the 99% level.
[2] Coefficient of variation.
[3] Ends down per 1,000 spindle hours.

quality. However, when the various fiber properties, including lint color, were included in multiple regression analyses to determine their separate effects on processing results, color seldom made a large contribution (table 4). The exception was color grade of yarn, which was closely related to lint color.

When standardized partial regression coefficients (beta values) were used as criteria, lint color ranked first or second in explaining variation in ends down or break factor in only three of the 16 cases (table 4). In a systematic deletion of independent variables from the regression equations, dropping lint color reduced the percent of variation explained at the 95-percent significance level in only two cases. This indicates that lint color ranked high primarily because of its correlation with other independent variables. The extent of this correlation is shown in Appendix tables 13 and 14.

Most of the cottons in which color was important in explaining variation in ends down or break factor came from the southeastern area. This may indicate that some unmeasured factor related to color, particularly in the southeastern cottons, was associated with ends down and break factor. However, lint color usually ranked last or next to last in importance and usually did not explain a significant amount of variation in the dependent variables when other fiber qualities were included in the equation. The extent of a lint color effect over wide ranges of color cannot be determined from these data, since relatively narrow ranges of color were represented in the cotton sampled.

It must be concluded that fiber properties other than lint color were responsible for most of the variations in processing results. This finding agrees with that of the 1965 color study.[5]

To further document the true effect that lint-color differences, brought about by exposure, have on fiber properties, processing performance, and yarn properties, cottons from two top crops were compared (harvested on November 10 and Decem-

[5] Shanklin, LaFerney, and Garner. See footnote 4, page 2.

TABLE 4.—*Summary of beta coefficients and $R^2 \times 100$, control and commercial cottons, for four areas of growth*

Dependent variable	Area of growth	Independent variable—beta coefficient						$R^2 \times 100$
		Colorimeter cleaned lint	Micronaire	Shirley Analyzer	2.5% span length	50/2.5 uniformity ratio	Pressley strength	Percent variation explained
EDMSH:[1]								
Control cotton	South Carolina	[2] −0.362 (4)	0.384 (2)	0.218 (5)	−0.794 (1)	0.114 (6)	−0.375 (3)	82
	Mississippi	.020 (6)	−.196 (3)	−.141 (5)	−.682 (1)	.152 (4)	.230 (2)	54
	Texas	−.184 (4)	−.040 (6)	.385 (2)	−.352 (3)	−.399 (1)	−.240 (5)	50
	Arizona	.087 (5)	−.462 (1)	−.291 (4)	−.394 (2)	.328 (3)	−.087 (5)	62
Commercial cotton	South Carolina	−.518 (1)	.049 (6)	−.195 (4)	−.419 (2)	−.384 (3)	−.179 (5)	61
	Mississippi	−.036 (5)	.499 (3)	.127 (4)	−.613 (1)	−.579 (2)	−.017 (6)	70
	Texas	−.025 (6)	−.165 (3)	.047 (5)	−.431 (1)	−.084 (4)	−.371 (2)	61
	Arizona	.252 (3)	−.222 (4)	−.385 (2)	−.619 (1)	−.080 (6)	.169 (5)	65
BREAK FACTOR:								
Control cotton	South Carolina	.246 (2)	−.118 (5)	−.115 (6)	.611 (1)	.147 (4)	.192 (3)	79
	Mississippi	.206 (3)	.048 (5)	.256 (2)	.601 (1)	.058 (4)	.006 (6)	77
	Texas	.037 (6)	.040 (5)	−.441 (2)	.399 (3)	.624 (1)	.188 (4)	67
	Arizona	−.333 (2)	.633 (1)	.040 (5)	.052 (4)	−.039 (6)	.238 (3)	72
Commercial cotton	South Carolina	.165 (5)	−.372 (2)	−.628 (1)	.006 (6)	−.170 (4)	.322 (3)	85
	Mississippi	.226 (5)	−.359 (2)	−.039 (6)	.622 (1)	.314 (3)	.292 (4)	84
	Texas	.201 (5)	.247 (4)	.446 (3)	.548 (2)	−.043 (6)	.654 (1)	63
	Arizona	−.069 (4)	−.007 (6)	.318 (2)	.695 (1)	.074 (3)	.044 (5)	63

[1] Ends down per 1,000 spindle hours.
[2] Numbers in parentheses indicate relative importance of property in predicting variations in dependent variables.

ber 1). As in the regular controlled test, the true lint color, as reflected by colorimeter grade index of cleaned lint, dropped one full grade due to exposure (table 5). In this case, neither the classer nor the colorimeter reading detected the difference in the ginned lint. This result confirms the finding in the controlled test (table 2). Color changed one grade due to exposure, but the classer did not detect it, and the colorimeter measurement on ginned lint detected only part of it.

Again, as in the controlled test, EDMSH was higher and break factor was lower for the cotton of lower color grade. But these differences were explained by other fiber properties which were also different in the two cottons—primarily length in the case of EDMSH, and both length and strength in the case of break factor.

Three findings of the controlled test need to be emphasized: (1) the classer was unable to detect the differences in color of ginned lint, (2) the colorimeter found part of the difference but was influenced by trash content, and (3) usually, the true color differences were not significantly related to the important processing properties studied, other than yarn color.

Effect of Purchase Period—Commercial Cotton

Although there was no direct control of exposure time in this phase, bales were purchased from commercial sources at intervals corresponding to the harvest dates of the controlled phase, to check the importance of lint color as a quality factor in the commercial market.

Table 6 summarizes results of this phase. Since neither foreign matter nor background color varied appreciably, none of the color determinations varied significantly across purchase dates. Thus, in the commercial phase, color showed no relation to other properties. Again, this confirms the findings of the 1965 color study.[6] The slight variations in EDMSH and break factor resulted primarily from slight variations in length and length uniformity (table 6).

[6] Shanklin, LaFerney, and Garner. See footnote 4, page 2.

TABLE 5.—*Comparison of certain properties from early harvest and top-crop harvest, control cotton, South Carolina*

Property [1]	Unit	Harvest period		
		Early, Oct. 12	Top crop [2]	
			Nov. 10	Dec. 1
Shirley Analyzer	Percent	3.4	4.4	3.7
Classer's leaf grade	Index	94	97	97
Classer's color grade	do	100	94	94
Colorimeter:				
Ginned lint	do	96	94	94
Cleaned lint	do	100	100	94
Classer's staple	1/32 inch	35	35	34
2.5% span length	Inch	1.14	1.12	1.10
50/2.5 uniformity ratio	Percent	45.7	42.5	42
Pressley strength	1,000 p.s.i.[3]	75	74	72
Micronaire	Reading	4.7	3.7	3.6
EDMSH [4]	Number	25	44	76
Break factor	Unit	1,832	1,854	1,703
Yarn irregularity	Percent	21.9	22.9	24
Yarn color:				
Gray	Index	99	98	92
Bleached	do	99	100	96
Bleached and dyed	do	97	98	92

[1] Maximum seed cotton cleaning condition.
[2] Average of 2 bales per harvest.
[3] Pounds per square inch.
[4] Ends down per 1,000 spindle hours.

TABLE 6.—*Average properties of commercial cotton purchased at three periods during the harvest season, 1966 color and trash level study*

Property	Unit	Purchase period [1]		
		Early, 36 lots	Midseason, 36 lots	Late, 33 lots
Shirley Analyzer	Percent	3. 0	3. 8	3. 7
Classer's leaf grade	Index	98. 1	94	96. 2
Classer's color grade	do	96. 2	95. 1	96. 4
Colorimeter:				
Ginned lint	do	97	97	98
Cleaned lint	do	99	99	100
Classer's staple	1/32 inch	34	34	34. 1
2.5% span length	Inch	1. 07	1. 08	1. 08
50/2.5 uniformity ratio	Percent	43. 9	44	43. 2
Pressley strength	1,000 p.s.i.[2]	81	78	77
Micronaire	Reading	4. 3	4. 1	3. 7
EDMSH [3]	Number	52	46	37
Break factor	Unit	1, 860	1, 860	1, 883
Yarn irregularity	Percent	22. 4	22. 4	22. 6
Yarn color:				
Gray	Index	96	97	99
Bleached	do	105	104	105
Bleached and dyed	do	104	104	105

[1] All results based on beltwide averages, except yarn color index, which is based on results from South Carolina and Mississippi areas only.
[2] Pounds per square inch.
[3] Ends down per 1,000 spindle hours.

Effect of Trash Level—Control Cotton

Ginning procedures were varied to produce three distinct levels of foreign matter (table 7). Both the classer and the colorimeter showed about a one-grade rise in color grade as foreign matter was reduced from high to low, or from 9 to 3.2 percent nonlint content. However, the cleaned-lint color grade did not vary significantly.

Therefore, in this study, the variation in lint color measurements produced by the variations in ginning procedures about equalled that produced by 8 weeks' exposure. Only in the latter case were the color differences real, however. This finding constitutes another reason for questioning the current emphasis on color as a pricing factor: as presently measured, color is very dependent on amount of foreign matter. In the cottons tested, prices of the cottons with the most foreign matter would have been discounted twice under the present marketing system—once for trash content and once for the apparent color reduction.

Again, the variations in EDMSH and break factor were primarily related to variations in properties other than color—in this case length properties (table 7).

Effect of Trash Level—Commercial Cotton

The commercial cottons differed in foreign matter from one grade class to another, but not so widely as did the control cottons. The Shirley Analyzer test showed a range of 2.9 to 4.3 percent nonlint content (table 8).

In the commercial market, one would expect to find lint color differences among different grades of cotton. However, in this phase of the study, the colorimeter measurements of cleaned lint indicated no difference in color among grades. In this set of cottons, color was not highly correlated with other fiber properties or with processing results—it simply did not vary appreciably.

Although no color differences existed among grades according to cleaned lint determinations, both the classer and the colorimeter found "color differences" in the ginned lint amounting to almost one grade (table 8). The reason is found in the Shirley Analyzer determination of nonlint con-

TABLE 7.—*Effect of trash content on selected properties, 1966 color and trash level study, control cotton*

Property	Unit	Trash content [1]		
		High, 36 lots	Medium, 36 lots	Low, 27 lots
Shirley Analyzer	Percent	9	4. 4	3. 2
Classer's leaf grade	Index	86. 2	94. 9	98. 3
Classer's color grade	do	87. 6	93. 7	95. 1
Colorimeter:				
Ginned lint	do	88	94	95
Cleaned lint	do	97	97	98
Classer's staple	1/32 inch	33. 8	34	33. 9
2.5% span length	Inch	1. 09	1. 08	1. 07
50/2.5 uniformity ratio	Percent	45. 1	44. 1	44. 3
Pressley strength	1,000 p.s.i.[2]	80	80	79
Micronaire	Reading	4. 3	4. 3	4. 3
EDMSH [3]	Number	60	72	97
Break factor	Unit	1, 839	1, 825	1, 798
Yarn irregularity	Percent	21. 9	22. 3	22. 6
Yarn color:				
Gray	Index	96	96	96
Bleached	do	101	101	102
Bleached and dyed	do	100	99	100

[1] All results based on beltwide averages, except yarn color index, which is based on results from South Carolina and Mississippi areas only.
[2] Pounds per square inch.
[3] Ends down per 1,000 spindle hours.

TABLE 8.—*Average properties of three grades of commercial cotton, 1966 color and trash level study*

Property	Unit	Trash content [1]		
		Grade 3	Grade 2	Grade 1
Shirley Analyzer	Percent	4. 3	3. 4	2. 9
Classer's leaf grade	Index	91. 3	97. 1	99. 8
Classer's color grade	do	94. 1	95. 5	98
Colorimeter:				
Ginned lint	do	96	98	99
Cleaned lint	do	99	99	100
Classer's staple	1/32 inch	33. 9	34. 1	34. 1
2.5% span length	Inch	1. 08	1. 08	1. 07
50/2.5 uniformity ratio	Percent	43. 4	43. 9	44
Pressley strength	1,000 p.s.i.[2]	78	79	80
Micronaire	Reading	3. 9	4. 1	4. 2
EDMSH [3]	Number	47	40	48
Break factor	Unit	1, 885	1, 862	1, 874
Yarn irregularity	Percent	22. 5	22. 5	22. 4
Yarn color:				
Gray	Index	97	96	99
Bleached	do	104	105	105
Bleached and dyed	do	103	105	105

[1] All results based on beltwide averages, except yarn color index, which is based on results from South Carolina and Mississippi areas only.
[2] Pounds per square inch.
[3] Ends down per 1,000 spindle hours.

tent. Greater amounts of trash in the low-grade cotton reduced the ginned-lint color indexes. Once again, this shows the strong dependence of ginned-lint color readings on trash content.

There were only slight variations in other fiber properties and in the processing results.

Discussion and Recommendations

Aside from difficulties of measurement, color was found to be of relatively minor importance in explaining variations in processing performance and yarn qualities other than yarn color. The reason that lint color does not explain processing and yarn quality variables is that heredity and environment determine the quality factors in cotton until the boll opens. Fiber strength at the time of boll opening, for example, can be 70,000 pounds per square inch for one cotton and 95,000 pounds for another, while both have a bright color.[7] We cannot depend on color in the commercial crop for a consistent indication of fiber strength or any other fiber property, because cotton variety and growth conditions influence these fiber properties. This explains, to a large extent, why lint color ranks low among fiber properties in predicting variations in processing results.

[7] NEWTON, FRANKLIN E., BURLEY, SAMUEL T., JR., and SHANKLIN, EDWARD H. FACTORS INFLUENCING THE QUALITY OF COTTON AND YARN IN RELATION TO MANUFACTURING EFFICIENCY. Presented at Extension Specialists' Cotton Quality Conference, Greenville, S.C., May 1967.

The findings of the present study strongly indicate a need for changes in the pricing system and the classification of cotton. The following changes are recommended, with a plea for prompt action:

1. Greatly reduce the emphasis on color as a pricing factor. Instead of being ranked among the most important pricing factors, it should be regarded as one of the least important.

2. Give high priority to perfecting an automated, practical system for grading cotton, which includes measurements of those fiber properties that effectively predict yarn properties and processing performance. These would include fiber length, length uniformity, fineness, strength, and leaf.

3. Perfect the system of determining color of cleaned-lint samples so that color and trash elements can be maintained separately, or develop factors to adjust ginned-lint color measurements to true color measurements. As color is now measured, in the presence of varying amounts of trash, it can be completely misleading.

Why perfect a system for measuring color if it is to be deemphasized in the pricing of cotton? First, since lint color is related to gray yarn color and to yarn dyeing properties, lint-color determinations provide a manufacturing control factor to assure uniformity of yarn color. Second, the grading system must make provision for determining color on the small percentage of cotton that has a truly low color grade. Third, the color test, potentially, can be made very economically and rapidly and could easily be incorporated into an automated fiber-testing line.

APPENDIX TABLES

TABLE 9.—*Average properties for South Carolina control cotton at three trash levels and harvest dates, 1966 color and trash level study*

Property	Unit	High trash				Medium trash				Low trash			
		Early harvest	Mid-season harvest	Late harvest	Average	Early harvest	Mid-season harvest	Late harvest	Average	Early harvest	Mid-season harvest	Late harvest	Average
Shirley Analyzer	Percent	12. 1	13. 2	11. 8	12. 4	5. 6	5. 6	4. 6	5. 3	3. 4	3. 4	2. 8	3. 2
Classer's leaf grade	Index	76	79	82	79	88	94	94	92	94	94	100	96
Classer's color grade	do	83	88	85	85. 3	94	94	94	94	100	94	94	96
Colorimeter:													
Ginned lint	do	85	85	82	84	94	94	91	93	96	94	94	95
Cleaned lint	do	100	96	97	97	100	98	94	97	100	98	94	97
Classer's staple	1/32 inch	35. 3	35. 3	35. 3	35. 3	36	36	35. 7	35. 9	36	35. 3	36	35. 8
2.5% span length	Inch	1. 15	1. 14	1. 13	1. 14	1. 15	1. 13	1. 12	1. 13	1. 14	1. 13	1. 11	1. 13
50/2.5 uniformity ratio	Percent	46	46	44	45	47	46	44	46	46	45	44	45
Pressley strength	1,000 p.s.i.[1]	74	75	72	74	74	73	72	73	75	72	74	74
Micronaire	Reading	4. 7	4. 5	4. 4	4. 5	4. 6	4. 4	4. 4	4. 5	4. 7	4. 4	4. 4	4. 5
EDMSH [2]	Number	36	41	48	42	26	31	59	39	25	34	65	41
Break factor	Unit	1, 809	1, 794	1, 673	1, 759	1, 828	1, 783	1, 680	1, 764	1, 832	1, 752	1, 656	1, 747
Yarn irregularity	Percent	21. 5	21. 9	22. 5	22	21. 7	21. 8	22. 6	22	21. 9	22. 5	23	22. 5
Yarn color:													
Gray	Index	97	96	92	95	99	96	92	96	99	96	92	96
Bleached	do	102	99	95	99	101	99	95	98	103	100	96	100
Bleached and dyed	do	104	99	93	99	103	95	94	97	106	99	91	99

[1] Pounds per square inch. [2] Ends down per 1,000 spindle hours.

TABLE 10.—*Average properties for Mississippi control cotton at three trash levels and harvest dates, 1966 color and trash level study*

Property	Unit	High trash				Medium trash				Low trash			
		Early harvest	Mid-season harvest	Late harvest	Average	Early harvest	Mid-season harvest	Late harvest	Average	Early harvest	Mid-season harvest	Late harvest	Average
Shirley Analyzer	Percent	7.3	7.6	6.8	7.2	3.7	2.8	2.7	3.1	2.2	2.2	2.5	2.3
Classer's leaf grade	Index	85	85	79	83	94	91	91	92	96	100	96	97.3
Classer's color grade	do	89	91	83.3	87.7	94	94	94	94	95	98	94	95.7
Colorimeter:													
Ginned lint	do	91	88	85	88	94	94	94	94	98	94	94	95
Cleaned lint	do	100	98	94	97	100	98	94	97	100	100	94	98
Classer's staple	1/32 inch	35	34.7	35	34.9	35	35	35	35	35	35	35	35
2.5% span length	Inch	1.10	1.08	1.08	1.09	1.09	1.08	1.07	1.08	1.08	1.07	1.08	1.08
50/2.5 uniformity ratio	Percent	45.7	45.3	44.7	45.2	45	45	45	45	45	45.3	45	45.1
Pressley strength	1,000 p.s.i.[1]	83	83	83	83	85	84	82	84	83	81	81	82
Micronaire	Reading	5.3	5.2	5.2	5.2	5.3	5.2	5.2	5.2	5.2	5.3	5.1	5.2
EDMSH [2]	Number	37	80	77	65	49	95	97	80	91	119	117	109
Break factor	Unit	1,893	1,826	1,797	1,839	1,835	1,793	1,770	1,799	1,813	1,786	1,791	1,796
Yarn irregularity	Percent	21.3	21.8	21.5	21.5	21.6	21.7	21.9	21.7	22	21.9	22.1	22
Yarn color:													
Gray	Index	98	98	92	96	98	98	92	96	98	99	93	97
Bleached	do	107	105	98	103	108	103	99	103	107	106	102	105
Bleached and dyed	do	104	102	97	101	103	100	98	100	106	100	96	101

[1] Pounds per square inch. [2] Ends down per 1,000 spindle hours.

TABLE 11.—*Average properties for Texas High Plains control cotton at three trash levels and harvest dates, 1966 color and trash level study*

Property	Unit	High trash				Medium trash				Low trash			
		Early harvest	Mid-season harvest	Late harvest	Average	Early harvest	Mid-season harvest	Late harvest	Average	Early harvest	Mid-season harvest	Late harvest	Average
Shirley Analyzer	Percent	11. 1	9. 9	10. 1	10. 4	5. 1	6	5. 9	5. 7	4. 3	5	4	4. 4
Classer's leaf grade	Index	94	91	94	93	100	97. 7	100	99. 2	100	101. 3	101. 3	100. 9
Classer's color grade	do	89. 6	86. 3	93	89. 6	93	93	93	93	93	95	93	93
Colorimeter:													
Ginned lint	do	86. 3	89. 7	86. 3	87. 4	93	93	93	93	95. 3	93	93	94
Cleaned lint	do	95	95. 3	95	95. 1	99	93	93	95	97	97	93	96
Classer's staple	1/32 inch	32	31. 3	30. 3	31. 2	31. 3	31. 3	30	30. 9	30. 7	30. 7	30. 3	30. 6
2.5% span length	Inch	1. 06	1. 05	1. 03	1. 05	1. 04	1. 03	1. 01	1. 03	1. 03	1. 02	1. 00	1. 02
50/2.5 uniformity ratio	Percent	46. 3	45	44	45. 1	43. 7	42. 7	41. 7	42. 7	44. 3	43. 3	42. 7	43. 4
Pressley strength	1,000 p.s.i.[1]	79	77	79	78	79	78	77	78	78	78	77	78
Micronaire	Reading	2. 9	3	2. 8	2. 9	2. 7	2. 7	2. 6	2. 7	2. 8	2. 7	2. 7	2. 7
EDMSH [2]	Number	39	71	117	76	54	60	172	95	32	43	155	77
Break factor	Unit	2, 132	2, 065	1, 875	2, 024	2, 079	2, 004	1, 892	1, 992	2, 009	1, 991	1, 871	1, 977
Yarn irregularity	Percent	21. 9	22. 9	23. 9	22. 9	23. 3	23. 9	24. 7	24	22. 8	23. 9	24. 6	23. 8

[1] Pounds per square inch. [2] Ends down per 1,000 spindle hours.

TABLE 12.—*Average properties for Arizona control cotton at three trash levels and harvest dates, 1966 color and trash level study*

Property	Unit	High trash				Medium trash				Low trash			
		Early harvest	Mid-season harvest	Late harvest	Average	Early harvest	Mid-season harvest	Late harvest	Average	Early harvest	Mid-season harvest	Late harvest	Average
Shirley Analyzer	Percent	6. 9	5. 1		6	3. 3	3. 3		3. 3	2. 7	2. 8		2. 8
Classer's leaf grade	Index	91	94		92. 5	94	100		97	98	100		99
Classer's color grade	do	86	89		87. 5	91. 7	96		93. 8	97	97		97
Colorimeter:													
Ginned lint	do	91	94		92	94	94		94	96	96		96
Cleaned lint	do	100	100		100	100	100		100	101	100		100
Classer's staple	1/32 inch	34. 3	34		34. 2	35	34. 3		34. 6	34. 3	34. 3		34. 3
2.5% span length	Inch	1. 09	1. 10		1. 10	1. 09	1. 07		1. 08	1. 06	1. 05		1. 06
50/2.5 uniformity ratio	Percent	44. 7	44. 7		44. 7	48. 3	42. 3		45. 3	43. 7	43. 7		43. 7
Pressley strength	1,000 p.s.i.[1]	90	87		88	88	86		87	88	87		88
Micronaire	Reading	5. 2	4. 8		5	5. 1	4. 8		5	5. 2	4. 8		5
EDMSH [2]	Number	36	79		58	38	115		76	94	228		161
Break factor	Unit	1, 802	1, 667		1, 734	1, 813	1, 674		1, 744	1, 701	1, 645		1, 673
Yarn irregularity	Percent	20. 9	21. 5		21. 2	20. 9	22. 2		21. 6	21. 8	22. 4		22. 1

[1] Pounds per square inch. [2] Ends down per 1,000 spindle hours.

TABLE 13.—*Simple correlation coefficients among selected independent variables, control cotton*

Area and independent variable	Color cleaned lint	Micronaire	Shirley Analyzer	2.5% span length	Uniformity ratio	Pressley strength
South Carolina:						
Color, cleaned lint	1.00					
Micronaire	.58**	1.00				
Shirley Analyzer	−.40*	.28	1.00			
2.5% span length	.52**	.62**	.41*	1.00		
Uniformity ratio	.55**	.68**	.17	.76**	1.00	
Pressley strength	.45*	.63**	.24	.47*	.40*	1.00
Mississippi:						
Color, cleaned lint	1.00					
Micronaire	.32	1.00				
Shirley Analyzer	.08	.23	1.00			
2.5% span length	.37*	.25	.42*	1.00		
Uniformity ratio	.21	−.06	.09	.43*	1.00	
Pressley strength	.41*	.16	.08	.29	−.11	1.00
Texas:						
Color, cleaned lint	1.00					
Micronaire	.19	1.00				
Shirley Analyzer	−.14	.41*	1.00			
2.5% span length	.09	.30	.59**	1.00		
Uniformity ratio	.20	.66**	.57**	.53**	1.00	
Pressley strength	.00	.12	.16	.16	.40*	1.00
Arizona:						
Color, cleaned lint	1.00					
Micronaire	.26	1.00				
Shirley Analyzer	−.23	.30	1.00			
2.5% span length	−.25	.21	.51*	1.00		
Uniformity ratio	−.17	.20	.57*	.58**	1.00	
Pressley strength	−.23	.61**	.35	.42	.31	1.00

*Significant at the 95-percent level. **Significant at the 99-percent level.

TABLE 14.—*Simple correlation coefficients among selected independent variables, commercial cotton*

Area and independent variable	Color cleaned lint	Micronaire	Shirley Analyzer	2.5% span length	Uniformity ratio	Pressley strength
South Carolina:						
Color, cleaned lint	1.00					
Micronaire	−.16	1.00				
Shirley Analyzer	−.49**	−.52**	1.00			
2.5% span length	.32	−.45*	.10	1.00		
Uniformity ratio	−.15	.70**	−.39*	−.29	1.00	
Pressley strength	.55**	−.27	−.33	.52**	−.04	1.00
Mississippi:						
Color, cleaned lint	1.00					
Micronaire	−.33	1.00				
Shirley Analyzer	.06	−.69**	1.00			
2.5% span length	−.14	−.25	.50**	1.00		
Uniformity ratio	.27	.60**	−.43*	−.11	1.00	
Pressley strength	−.05	.16	−.08	.24	.34	1.00
Texas:						
Color, cleaned lint	1.00					
Micronaire	.49**	1.00				
Shirley Analyzer	−.24	−.64**	1.00			
2.5% span length	−.13	.43*	−.43*	1.00		
Uniformity ratio	.03	.29	−.39*	.33	1.00	
Pressley strength	−.05	.17	−.42*	.14	.65**	1.00
Arizona:						
Color, cleaned lint	1.00					
Micronaire	−.15	1.00				
Shirley Analyzer	.34	−.36	1.00			
2.5% span length	−.07	.64**	−.10	1.00		
Uniformity ratio	−.12	.64**	−.07	.59**	1.00	
Pressley strength	.07	.47*	.18	.46*	.34	1.00

*Significant at the 95-percent level. **Significant at the 99-percent level.

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